SECTION 5.0

Electric Transmission

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5.1 Introduction

Section 5.0 discusses the transmission interconnection between the San Francisco Electric Reliability Project (SFERP) and the existing electrical grid, and the anticipated impacts that operation of the facility will have on the flow of electrical power in the San Francisco region of California. To better understand the impacts of the proposed SFERP on transmission and power flows, the discussions in this section focus on those areas that allow a critical review of the electrical transmission and interconnection. More specifically, this analysis will contain discussions of:

- The proposed electrical interconnection between SFERP and the electrical grid
- The proposed electrical transmission line alignment
- The impacts of the electrical interconnection on the existing transmission grid
- Potential nuisances (electrical effects, aviation safety, and fire hazards)
- Safety of the interconnection
- Description of applicable laws, ordinances, regulations, and standards (LORS)

The proposed SFERP site is located in an industrial area of the City and County of San Francisco (CCSF), California. This location was selected, in part, for its proximity to the Pacific Gas and Electric Company's (PG&E's) Potrero Switching Substation. Figure 5-1 (all figures are located at the end of this section) shows the location of SFERP in relationship to the Potrero Substation. This location, near the Potrero substation, will allow for short interconnecting transmission lines to SFERP.

The SFERP 115-kilovolt (kV) transmission line will be directly connected to PG&E's transmission system through the Potrero Substation. Two interconnections to the substation will be constructed by using two existing switchyard bays. There are currently three bays available for 115-kV lines in the switchyard located north of Humboldt Street.

5.2 Transmission Interconnection

SFERP will link to the power grid through the PG&E Potrero Substation by two redundant three-phase 115-kV solid dielectric underground transmission circuits. The proposed 115-kV route will exit north from SFERP into 25th Street and then proceed west along 25th Street until turning north into Michigan Street. The transmission line will turn west from Michigan Street into 24th Street. The line will intersect Illinois Street and continue north to the PG&E Potrero Switchyard. PG&E is currently performing a Facilities Study to evaluate the feasibility of two alternatives to route the transmission line from Illinois Street to the Potrero switchyard. The two alternatives are to (1) enter the Potrero switchyard underground from Illinois Street or (2) continue north to 22nd Street and enter the switchyard from 22nd street. If the 22nd Street route is selected, the circuits would then run east in 22nd Street to an underground/overhead transition structure located on the eastern portion of the

switchyard. An overhead line would then connect with the switchyard bus in an overhead arrangement.

The preferred method of construction will be the use of an open trench. In the intersections of Illinois Street with 23rd and 24th streets, there are numerous existing utilities to be avoided. In these cases, jack-and-bore construction techniques may be the most suitable construction approach. The final decision on construction methodology will be developed during the detailed design phase.

From the SFERP switchyard to the connection at the Potrero Substation breakers, the total transmission distance is approximately 3,000 feet. This is the most direct route, without going through private property, between SFERP and the PG&E switchyard.

5.3 SFERP Switchyard

The SFERP switchyard will contain five 115-kV, sulfur-hexafluoride- (SF_6) insulated, dead-tank, high-voltage circuit breakers in a 3-phase ring bus configuration. The main conductors of the ring bus and connections to the generator step-up transformers will be uninsulated tubular aluminum bus bars supported on steel structures with porcelain insulators. Each transformer will connect to a separate node of the ring. The two 3-phase circuits connecting the SFERP switchyard with the Potrero Substation will also be connected to separate nodes on the ring. Two aboveground to underground transition structures will be used to transition these circuits from the open bus work to the underground transmission cables. For operational flexibility and maintenance, 3-pole disconnect switches will be located on each side of each breaker and between each transformer and the ring bus.

Appropriate voltage and current sensing instruments will be provided on the ring bus, and the connections to the ring bus provide complete metering and electrical protection. The ring bus will be supported by a comprehensive protective relaying scheme, including over current and differential current relaying, to ensure a fast response to abnormal conditions that will isolate the affected area and permit continued service of the unaffected parts of the bus. The circuit breaker controls and protective relays will be housed in a relay panel located in the main control room. The switchyard will also be monitored through the plant control system where breaker position and system parameters will be available to the operator in the main control room. The plant control system will also display all alarm conditions associated with the switchyard.

5.4 Interconnection System Impact Study

The City of San Francisco (City) submitted a completed Interconnection Application (IA) to the California Independent System Operator Corporation (CAISO) for the SFERP. The proposed project at that time consisted of four LM6000 units rated at 48.7 megawatts (MW) each and one steam turbine rated at 15 MW. The maximum output of the proposed project would have been 209.8 MW. The online date of the proposed project was June 2005. Since the new plant arrangement with 3 simple-cycle LM6000 combustion turbines will have a lower output, the impact to the grid and PG&E local system is less. Therefore, a new system impact study was not required.

The proposed project will be connected to PG&E's transmission grid via new 115-kV generation tie lines. The System Impact Study (SIS) report presented the results for a plant of four LM6000 units and the one steam unit that would connect directly to PG&E's Potrero 115-kV Substation. A copy of the SIS was presented in Appendix 5A of the AFC.

This SIS identified:

- Transmission system impacts caused solely by the addition of the plant as described above
- System reinforcements, if any, necessary to mitigate the adverse impact under various system conditions

To determine the system impacts caused by the addition of the SFERP, studies were performed using the following full loop base cases:

- 2005 Summer Peak
- 2005 Fall Peak

The studies performed included:

- Steady State Power Flow
- Dynamic Stability Analysis
- System Protection

PG&E's evaluation was based on the assumption that Mirant Corporation's proposed Potrero Unit 7 project would not be built. At the time the system impact study was conducted, the City was proposing to locate the SFERP on the same location as that proposed for Potrero Unit 7. The City considers that it remains appropriate to assume that Potrero Unit 7 will not be built since the AFC for the facility is suspended, Mirant is in bankruptcy proceedings, and it is formal City policy to oppose the construction of Potrero Unit 7. PG&E's evaluation concluded that the addition of the SFERP would cause no normal overloads during conditions studied for 2005, provided that Potrero 7 is not online. The study showed that the project would exacerbate one transmission facility overload following Category B contingencies in the 2005 Summer Peak Base Case and none in the 2005 Fall Peak. Following Category C contingencies, the project would cause no overloads during the 2005 conditions studied. Mitigation of the pre-project and post-project overloads will be accomplished by PG&E's Potrero-Hunters Point (AP-1, scheduled for December 2005) 115-kV project which will be online prior to the Summer 2007 operational date for the SFERP.

The Substation Evaluation identified no overstressed equipment associated with the SFERP.

Dynamic Stability Study results indicated that the transmission system's transient performance, relative to the CAISO grid planning standards, would not be affected by the SFERP following selected disturbances.

Based on the results of the SIS conducted for a significantly larger SFERP, the SFERP will not adversely affect the grid.

5.5 Transmission Line Safety and Nuisance

This section discusses safety and nuisance issues associated with the proposed electrical interconnection of SFERP with the electrical grid. Construction and operation of the proposed underground transmission lines will be undertaken in a manner to ensure the safety of the public as well as maintenance crews while supplying power with minimal electrical interference.

5.5.1 Electrical Clearances

The proposed underground transmission lines will be encased in conduits within a concrete duct bank. Minimum clearances from other buried objects are specified in the National Electric Safety Code (NESC) and California Public Utilities Commission (CPUC) General Order 128 (GO 128). Electric utilities, state regulators, and local ordinances may specify additional (more restrictive) clearances. The proposed SFERP transmission interconnections will be designed to meet all national, state, and local code clearance requirements.

5.5.2 Electrical Effects

The electrical effects of high-voltage transmission lines fall into two broad categories: corona effects and field effects. Corona is the ionization of the air that occurs at the surface of the energized conductor and suspension hardware due to very high electric field strength at the surface of the metal during certain conditions. Corona may result in radio and television reception interference, audible noise, light, and production of ozone. Corona is generally a principle concern with transmission lines of 345 kV and higher. Field effects are the voltages and currents that may be induced in nearby conducting objects. The project's use of shielded solid dielectric cable encased in an underground concrete duct bank will eliminate the corona and field effects.

5.5.3 Aviation Safety

Federal Aviation Administration (FAA) Regulations, Part 77 establishes standards for determining obstructions in navigable airspace and sets forth requirements for notification of proposed construction. These regulations require FAA notification for any construction over 200 feet in height above ground level. Notification is also required if the obstruction is less than the above-specified height and falls within any restricted airspace in the approach to airports. The closest airport is Oakland International Airport approximately 34,000 feet to the east and therefore further than the 20,000 feet required for notification.

Based on the height of the underground to aboveground transition structures (which will not be higher than existing structures at the Substation), FAA notification is not needed. Furthermore, there are a number of existing transmission lines in proximity that are of comparable or taller height. As a result of their location and height in relation to the above airfield, the structures of the proposed electrical transmission interconnection will pose no deterrent to aviation safety as defined in the FAA regulations.

5.5.4 Fire Hazards

The proposed 115-kV transmission interconnection will be designed, constructed, and maintained in accordance with CPUC General Orders that establish clearances from other natural and constructed structures as well as tree-trimming requirements to mitigate fire hazards. The Applicant will use trained and qualified maintenance personnel to maintain the interconnection corridor and immediate area of the switchyard in accordance with accepted industry practices that will include recognition and abatement of any fire hazards.

5.6 Applicable Laws, Ordinances, Regulations, and Standards

This section provides a list of applicable LORS that apply to the proposed transmission line, substations and engineering.

5.6.1 Design and Construction

Table 5-1 lists the applicable LORS for the design and construction of the proposed transmission line and substations.

TABLE 5-1
Design and Construction LORS

LORS	Applicability	Supplement A Reference
GO-128, CPUC, "Rules for Underground Electric Line Construction"	CPUC rule covers required clearances, grounding techniques, maintenance, and inspection requirements.	Subsection 5.4
Title 8 CCR, Section 2700 et seq. "High Voltage Electrical Safety Orders"	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical installation and equipment to provide practical safety and freedom from danger.	Subsection 5.2
GO-52, CPUC, "Construction and Operation of Power and Communication Lines"	Applies to the design of facilities to provide or mitigate inductive interference.	Subsection 5.4
ANSI/IEEE 693, "IEEE Recommended Practices for Seismic Design of Substations"	Recommends design and construction practices.	Subsection 5.2
IEEE 1119, "IEEE Guide for Fence Safety Clearances in Electric-Supply Stations"	Recommends clearance practices to protect persons outside the facility from electric shock.	Subsection 5.3
IEEE 998, "Direct Lightning Stroke Shielding of Substations"	Recommends protections for electrical system from direct lightning strikes.	Subsection 5.3
IEEE 980, "Containment of Oil Spills for Substations"	Recommends preventions for release of fluids into the environment.	Subsection 5.3

5.6.2 Electric and Magnetic Fields

The applicable LORS pertaining to EMF interference are tabulated in Table 5-2.

TABLE 5-2
Electric and Magnetic Field LORS

LORS	Applicability	Supplement A Reference
Decision 93-11-013, CPUC	CPUC position on EMF reduction.	Subsection 5.5.2
GO-131-D, CPUC, "Rules for Planning and Construction of Electric Generation, Line, and Substation Facilities in California"	CPUC construction application requirements, including requirements related to EMF reduction.	Subsection 5.2
ANSI/IEEE 644-1994, "Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines"	Standard procedure for measuring EMF from an electric line that is in service.	Subsection 5.2

5.6.3 Hazardous Shock

Table 5-3 lists the LORS regarding hazardous shock protection that apply to the project.

TABLE 5-3
Hazardous Shock LORS

LORS	Applicability	Supplement A Reference
8 CCR 2700 et seq. "High Voltage Electrical Safety Orders"	Establishes essential requirements and minimum standards for installation, operation, and maintenance of electrical equipment to provide practical safety and freedom from danger.	Subsection 5.3
ANSI/IEEE 80, "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	Subsection 5.3
NESC, ANSI C2, Section 9, Article 92, Paragraph E; Article 93, Paragraph C	Covers grounding methods for electrical supply and communications facilities.	Subsection 5.3

5.6.4 Communications Interference

The applicable LORS pertaining to communication interference are tabulated in Table 5-4.

TABLE 5-4
Communications Interference LORS

LORS	Applicability	Supplement A Reference
47 CFR 15.25, "Operating Requirements, Incidental Radiation"	Prohibits operations of any device emitting incidental radiation that causes interference to communications; the regulation also requires mitigation for any device that causes interference.	Subsection 5.3
GO-52, CPUC	Covers all aspects of the construction, operation, and maintenance of power and communication lines and specifically applies to the prevention or mitigation of inductive interference.	Subsection 5.3
CEC staff, Radio Interference and Television Interference (RI-TVI) Criteria (Kern River Cogeneration) Project 82-AFC-2, Final Decision, Compliance Plan 13-7	Prescribes the CEC's RI-TVI mitigation requirements, developed and adopted by the CEC in past citing cases.	Subsection 5.3

5.6.5 Aviation Safety

Table 5-5 lists the aviation safety LORS that may apply to the proposed construction and operation of SFERP.

TABLE 5-5
Aviation Safety LORS

LORS	Applicability	AFC Reference
Title 14 CFR, Part 77, "Objects Affecting Navigable Airspace"	Describes the criteria used to determine whether a "Notice of Proposed Construction or Alteration" (NPCA, FAA Form 7460-1) is required for potential obstruction hazards.	Subsection 5.5.3
FAA Advisory Circular No. 70/7460-1G, "Obstruction Marking and Lighting"	Describes the FAA standards for marking and lighting of obstructions as identified by FAA Regulations Part 77.	Subsection 5.3.3
PUC, Sections 21656-21660	Discusses the permit requirements for construction of possible obstructions in the vicinity of aircraft landing areas, in navigable airspace, and near the boundary of airports.	Subsection 5.5.3

5.6.6 Fire Hazards

Table 5-6 tabulates the LORS governing fire hazard protection for SFERP.

TABLE 5-6
Fire Hazard LORS

LORS	Applicability	Supplement A Reference
14 CCR Sections 1250-1258, "Fire Prevention Standards for Electric Utilities"	Provides specific exemptions from electric pole and tower firebreak and electric conductor clearance standards, and specifies when and where standards apply.	Subsection 5.5.4
ANSI/IEEE 80, "IEEE Guide for Safety in AC Substation Grounding"	Presents guidelines for assuring safety through proper grounding of AC outdoor substations.	Subsection 5.3
GO-95, CPUC, "Rules for Overhead Electric Line Construction," Section 35	CPUC rule covers all aspects of design, construction, operation, and maintenance of electrical transmission line and fire safety (hazards).	Subsection 5.5

5.6.7 Jurisdiction

Table 5-7 identifies national, state, and local agencies with jurisdiction to issue permits or approvals, conduct inspections, and/or enforce the above-referenced LORS. Table 5-7 also identifies the associated responsibilities of these agencies as they relate to the construction and operation of SFERP.

TABLE 5-7
Jurisdiction

Agency or Jurisdiction	Responsibility
CEC	Jurisdiction over new transmission lines associated with thermal power plants that are 50 MW or more (Public Resources Code [PRC] 25500).
CEC	Jurisdiction of lines out of a thermal power plant to the interconnection point to the utility grid (PRC 25107).
CEC	Jurisdiction over modifications of existing facilities that increase peak operating voltage or peak kilowatt capacity 25 percent (PRC 25123).
FAA	Establishes regulations for marking and lighting of obstructions in navigable airspace (AC No. 70/7460-1G).
Local Electrical Inspector	Jurisdiction over safety inspection of electrical installations that connect to the supply of electricity (NFPA 70).
City and County of San Francisco	Establishes and enforces zoning regulations for specific land uses. Issues variances in accordance with zoning ordinances.
	Issues and enforces certain ordinances and regulations concerning fire prevention and electrical inspection.

FIGURE 5-1
LOCATION OF SFERP AND PG&E POTRERO SUBSTATION
SAN FRANCISCO ELECTRIC RELIABILITY PROJECT
SUPPLEMENT A

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